UNION SWITCH & SIGNAL

Four-Quadrant Gate Highway-Crossing Warning System

Safety at highway grade crossings long has been a concern of railroads, rail-transit properties and government at local, state and federal levels. At issue are impatient motorists who circumvent down crossing gates in an attempt to drive over the crossing before the arrival of a train. This frequently meets with fatal results to motorists and train crews. These concerns are especially acute in high-speed rail territory, where grade separation of highways and railways is not possible – and where the speed of the train makes it nearly impossible for the train operator to stop the train once the crossing comes into view and a motor vehicle stalled on the crossing becomes visible. To address these concerns and to attempt to improve grade-crossing safety for both motor vehicles and trains, particularly at high-speed locations, Union Switch & Signal has developed the Four-Quadrant Gate Highway-Crossing Warning System.

general description

With the US&S Four-Quadrant Gate Highway-Crossing Warning System, the grade crossing is treated as an interlocked junction between two rights-of-way, the street and the railroad track. The system primarily consists of four highway-crossing signal/gate assemblies, an inductive motor-vehicle detection loop, a vital/non-vital processor, a cab signal system interface in rail territory equipped with cab signaling, and approach and island track circuits. Gate operation is controlled so that motor vehicles will not be trapped on the crossing during the approach of a train.

Signal/Gate Assemblies

Two signal/gate assemblies are installed on each side of the track so the highway is completely blocked on both sides of the rail right-of-way when the gates are down and a train is approaching the crossing. The signal/gate assemblies are equipped with US&S Model 95 gate mechanisms. The gate mechanisms that are mounted on the signals installed on the exit-side of the crossing (the side through which a motor vehicle must pass when leaving the crossing) are designed to raise should power to the highway-crossing warning system fail. The entrance gates during such a circumstance will fall to the down position. This mitigates the possibility of a motor vehicle being trapped on the crossing by a down gate blocking the crossing location's exit-side lane.

Loop Detectors

Loop detectors are buried beneath the crossing surface for detecting motor vehicles. Since the loop detectors' inductance varies whenever a motor vehicle passes over the crossing, the presence of a motor vehicle on the crossing will be detected. The loop output is sent to the warning system's vital/non-vital processor. If a vehicle is on the crossing when a train approaches and activates the highway-crossing warning system, the exit gates will remain raised to allow the vehicle to exit the crossing. Once again, this feature provides an exit for the vehicle so it's not trapped on the crossing by all four gates being down.

Vital/Non-Vital Processor

The US&S Microlok® II Wayside Control System functions as a vital/non-vital processor, and it is the heart of the control system. It executes the vital logic required for gate operation, motor-vehicle detection, and the locomotive cab indications (VMI in cab signal territory) that alert the train engineer of a motor vehicle (or other obstruction) on the crossing. This processor also tests for loop-detector faults, crossing-system intrusion and broken gates, and, if any of these conditions are detected, it generates a maintenance call.

Track Circuits

The track circuits detect the presence of a train within the crossing approaches and on the island (where track and road meet), and they initiate operation of the highway-crossing warning system.

advantages

- Four-quadrant gate highway-crossing configuration.
- Motor-vehicle detection.
- Issues locomotive-cab warning.
  - Alerts train engineer of motor vehicle or other obstruction at the crossing so a train can stop before reaching the crossing.
- Gate-down indication.
- Broken-gate detection and indication.
- Counterbalanced exit gates rise if power fails so motor vehicles are not trapped in the crossing.
- Defective loop-detector test and indication.
- Abnormal-condition detection and indication.

operation

With no train approaching the crossing, the gates are vertical, the flashing warning lights on the signal gate assemblies are dark, the warning bell is silent, and the track-circuit relays are energized. The vital portion of the Microlok II system constantly monitors the status of the loop detectors that indicate whether a motor vehicle is traveling over or is stopped on the crossing. Loop status information also is passed to the non-vital portion of the Microlok II processor, which directs the information to a data logger for recording.

When a train enters one of the highway-crossing warning system's approach track circuits, the approach track-circuit relay is de-energized, the warning lights begin to flash, the bell begins to ring, and the vital processor checks if the crossing is occupied by a motor vehicle or other obstruction. If the crossing is clear (as determined via input from the motor-vehicle detection loops), the Microlok II processor will allow the gates to begin their descent seven seconds after the activation of the lights and the bell.

If, however, the crossing is blocked by a motor vehicle, for example, the Microlok II processor will allow the gates guarding the entrance lanes of the crossing to descend, but it will keep the exit gates raised to allow the vehicle to exit the crossing. At the same time, the locomotive cab signal (in cab signal territory) will be reduced from a clear indication to an approach-medium indication. If the crossing still is not clear 10 seconds later, the cab signal is reduced to an approach indication, and then to a restrictive indication 10 seconds later if the crossing still is obstructed. These cab-signal reduction points are located so the train can stop before reaching the crossing and, in the case of passenger trains or rail-transit vehicles, without causing alarm or discomfort among the passengers.

application

While the US&S Four-Quadrant Gate Highway-Crossing Warning System can be applied at any highway grade-crossing location, it's most effective in areas (railroad or rail transit) equipped with cab signaling/on-board vehicle control, where it can alert train operators to a motor vehicle or other obstruction on the crossing.

This system first was installed on AMTRAK high-speed territory at the School Street Crossing in West Mystic, Connecticut. The traffic characteristics at the School Street crossing are as follows:

- Passenger-train speeds of 70 mph.
- Freight-train speeds of 50 mph.
- 17 trains/day currently; 52 trains/day through the crossing by 2010.
- 900 motor vehicles/day through the crossing during tourist season; many vehicles with a boat in tow.
- School Street, West Mystic, Connecticut.
  - Sole access to Willow Point, a suburban/commercial area that includes a marina.
- Milepost 131.3 on Amtrak's Northeast Corridor.

Since the School Street installation, the US&S Four-Quadrant Gate Highway-Crossing Warning System has been installed at eight other grade-crossing locations on AMTRAK territory.

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